MODIFIED GHS COLLISION MODEL COMPARED WITH VHS MODEL

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The generalized hard sphere collision model (GHS) was introduced by Hassan and Hash [2]. It is generalization of the Sutherland collision model proposed by Kuscer [4]. At low temperatures, where the attractive intermolecular forces are important, the GHS collision model produces a more accurate variation of viscosity with temperature than the standard Variable Hard Sphere (VHS) collision model [1]. In spite of this, the GHS model remains virtually unused because of its great computational expense compared to the VHS model. A slight modification of the GHS model, described in [5], makes it no more than 5-15% more computationally expensive than the VHS model. We compare the GHS and VHS models for a blunt body flow with T_0 = 1300 K.

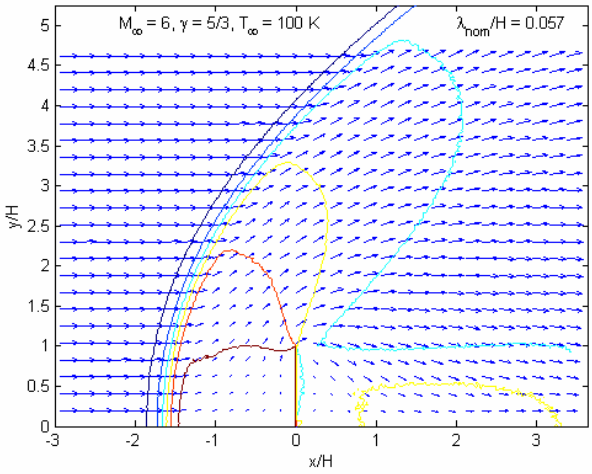

Fig. 1. Flat plate normal to flow. T contours and velocities. T_{wall} , front and back: 1300 K and 500 K.

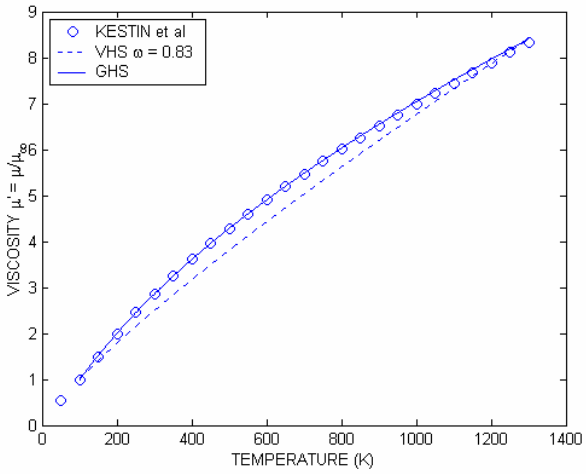

Fig. 2. Modified GHS and VHS viscosity, compared with viscosity recommended for argon [3].

We calculate the supersonic flow of Argon, with a freestream temperature of 100 K, around a flat plate normal to the freestream (see Fig. 1). The wall temperatures were 1300 K (front) 500 K (rear), with diffuse reflection. The viscosity for the modified GHS and VHS models used here are compared in Fig. 2 with the recommended argon viscosity [3], over the range of temperatures in the flow. The temperature in the wake region is ≅ 500 K, so the viscosity of the two models differs most there (see Fig. 2). This leads to small differences in the temperature field and the size of the re-circulation region. The GHS model required only 5% more CPU.

References

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